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(56) Documents Cited

GB 2167279 A EP 0489906 A

(58) Field of Search

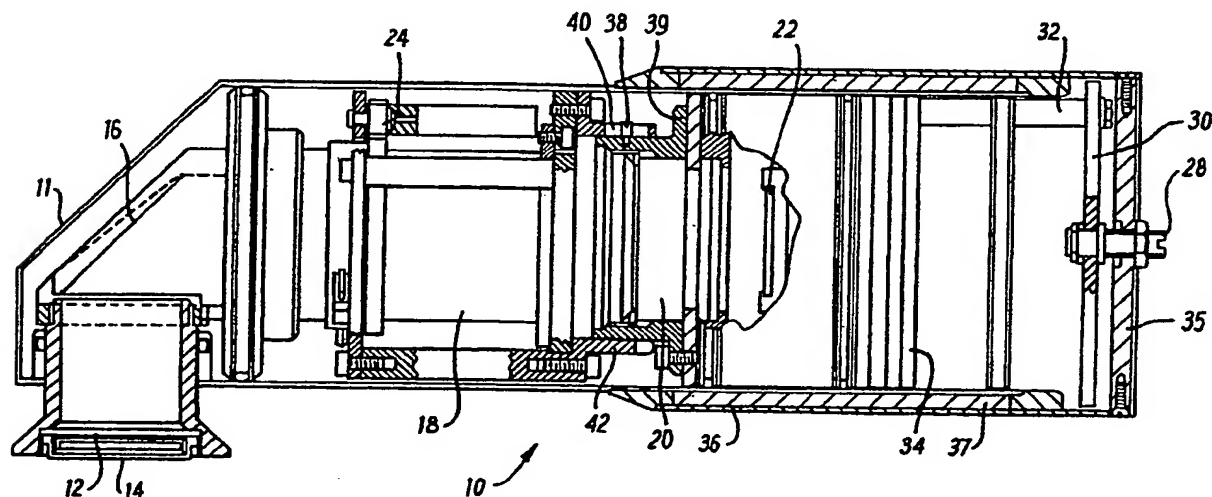
UK CL (Edition L) H5R REE REN REQ

INT CL⁵ A61B , H01J , H05G

Online databases:WPI,EDOC

(54) An inspection system

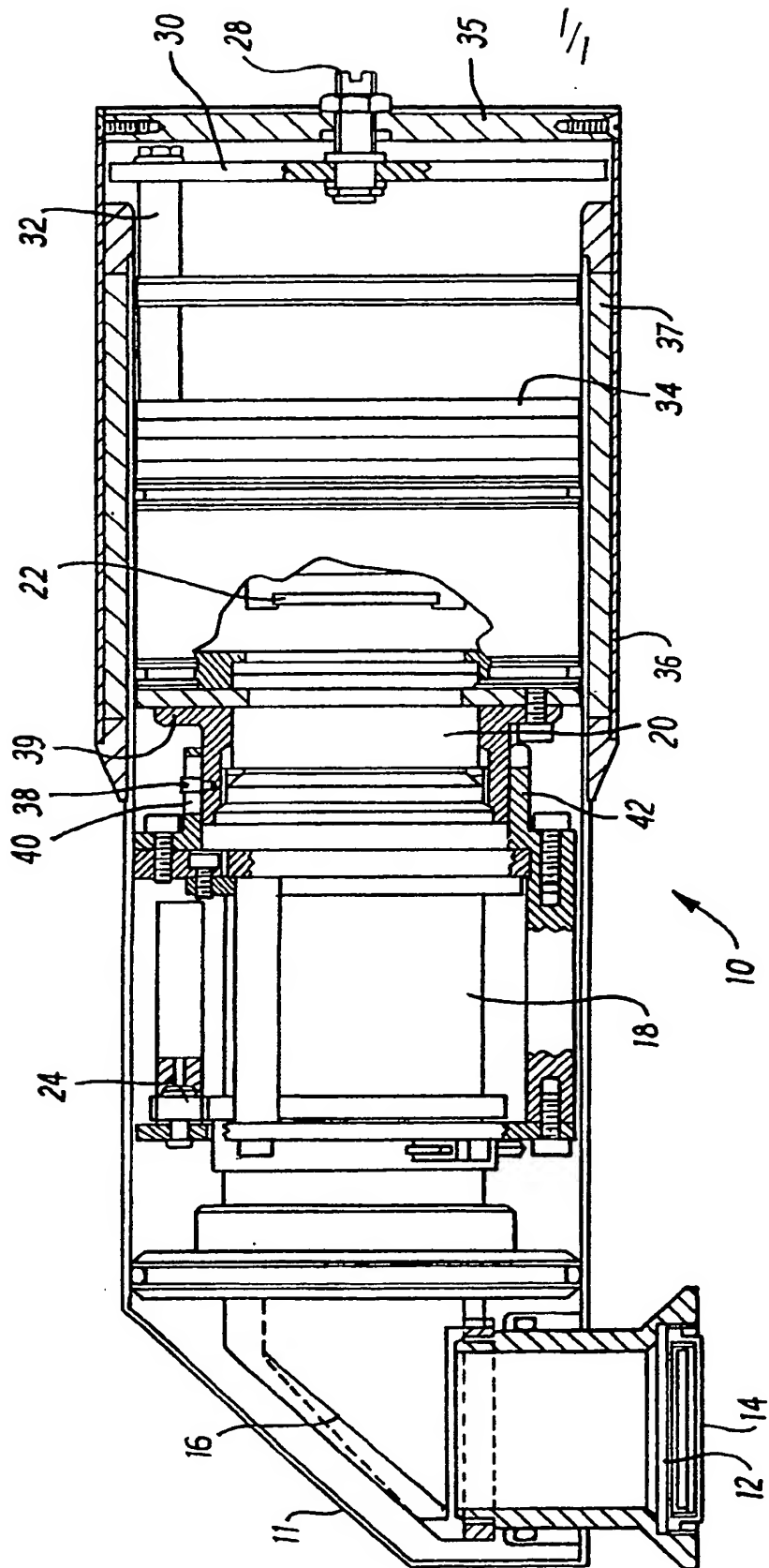
(57) A radioscopic inspection system which comprises an X-ray sensitive phosphorescent screen 12, a photodiode array 22, and optical means for transferring an image from the screen on to the photodiode array 22. The optical means comprises a lens system 18 and a reflector 16 between the screen and the lens system. The inspection system provides X-ray images in near real time of a quality at least equivalent to conventional X-ray film techniques. The photodiode array 22 is shielded from scattered X-rays by a lead-glass element 20 and cooled by a cooling circuit.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1990.

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An inspection system

This invention relates to an inspection system, and more particularly to a radioscopic inspection system.

In known radioscopic inspection systems the resultant images are usually of low resolution and relatively poor dynamic range with the images degraded by system noise, distortion, and artefacts caused by blur and detector overload.

It is an object of the present invention to provide radioscopic inspection of improved quality in near real time of work pieces.

According to one aspect of the present invention there is provided a radioscopic inspection system, the system comprising an X-ray sensitive phosphorescent screen, a photodiode array, and optical means for transferring an image from the screen on to the photodiode array.

Preferably, the optical means comprises a lens system, and may include a reflector between the screen and the lens system.

The invention will now be further described by way of example only with reference to the single Figure in the accompanying drawing which shows a medial sectional view of a radioscopic inspection system.

Referring to the Figure, an inspection system 10 is shown and comprises a casing 11 containing a phosphorescent screen 12 behind a thin cover plate 14 of a material of low X-ray absorption, such as aluminium, mica, beryllium, etc. A lead-glass front-silvered mirror 16 is positioned at about 45° to the screen 12 so as to reflect images from the screen 12 on to an optical lens system 18. The system 18 is able to provide a very high resolution at a wide numeric aperture, and includes an integral lead-glass

element 20 to shield an array of photodiodes 22 from scattered X-rays. A central motorised iris assembly 24 alters the numeric aperture of the optical lens system 18. The array of photodiodes 22 is cooled by a conventional circuit (not shown) to reduce dark current to a minimum, for example by use of a double Peltier cooling stack from which heat is removed by a water cooling circuit. Focusing of the system 10 is achieved by an adjustment screw 28 connected at one end to a plate 30 joined by several rods 32 (only one is shown) to a housing 34 for the photodiodes 22 and the lead glass element 20. The screw 28 extends through an end plate 35 of a sleeve 36 in which the casing 11 extends, the space between the casing 11 and the sleeve 36 being filled with lead shielding 37. A pin 38 at a hollow spigot portion 39 of the housing 34 locates in a slot 40 of a hollow spigot 42 from the lens system 18 and in which the spigot portion 39 slidably locates.

In use of the inspection system 10, a radiographic image of a workpiece (not shown) is formed by X-ray irradiation. The resultant shadowgraph image is detected by the screen 12, reflected by the mirror 16 to the lens system 18, from which the image is transmitted to the photodiodes 22. After a sufficient period of photon counting from the photodiodes 22 has occurred, the X-ray irradiation is stopped, and the photodiodes 22 read sequentially into a frame memory card mounted within a personal computer. Using a slow read out rate, data is digitised to sixteen bits and displayed. Typical dynamic ranges exceed 30,000:1. A resolution of the order of 50 microns has been achieved over a 35mm diagnostic length.

In one application of the invention a 1152 x 770 pixel array of photodiodes 22 has been used, but fewer or larger numbers of photodiodes 22 may also be used.

When the photodiodes 22 are cooled to sub-zero temperatures by the cooling circuit, substantially noise free images are obtained unaffected by photodiode dark current thus enabling photon counting of X-ray scintillations to take place over considerable periods of time.

The inspection system provides X-ray images in near real time of a quality at least equivalent to conventional X-ray film techniques and is capable of detecting defects to nuclear construction acceptance standards. The inspection system may be specifically used for Class I applications where images equal to or better than grain film radiography are required.

In a typical application, using suitable scanning arrangements and fixtures, the inspection system may be used to inspect critical weldments of circumferential and longitudinal geometries and small bore pipework. Indeed, the inspection system is particularly well suited for the inspection of workpieces such as small bore tubing, ordnance components and aerospace parts.

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Claims

1. A radiosopic inspection system, the system comprising an X-ray sensitive phosphorescent screen, a photodiode array, and optical means for transferring an image from the screen on to the photodiode array.
2. A system as in Claim 1 and wherein the optical means comprises a lens system, and a reflector between the screen and the lens system.
3. A system as in Claim 1 and wherein the photodiode array is shielded from scattered X-rays by a lead-glass element.
4. A system as in Claim 1 or Claim 3 and wherein the photodiode array is cooled by a cooling circuit.
5. A system as in Claim 4 and wherein the cooling circuit comprises a double Peltier cooling stack from which heat is removed by a water cooling circuit.
6. A system as in Claim 4 and wherein the photodiode array is cooled to below 0° Centigrade.
7. A system substantially as hereinbefore described with reference to the accompanying drawing.

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Patents Act 1977
 Examiner's report to the Comptroller under Section 17
 (The Search report)

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Relevant Technical Fields

- (i) UK Cl (Ed.L) H5R: REE, REQ, REN
 (ii) Int Cl (Ed.5) H05G, A61B, H01J

Search Examiner
 MR S SATKURUNATH

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 28 OCTOBER 1993

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-
 1-7

(ii) ONLINE DATABASES : WPI, EDOC

Categories of documents

- X:** Document indicating lack of novelty or of inventive step.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.
A: Document indicating technological background and/or state of the art.
P: Document published on or after the declared priority date but before the filing date of the present application.
E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2167279 A (REDMAYNE)	1
A	EP 0489906 A (VARIAN)	1

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).